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ABSTRACT

The Raggio Evaluation of Attention Deficit Disorder (READD) is an objective measure for the diagnosis and management of attention deficit disorder (ADD) in children. Extensive research has been conducted on its clinical and psychometric properties, as described in Chapter 3, "Development and Standardization." The READD is a microcomputer edition of the Continuous Performance Test (CPT), a test that has shown promise as a measure of attention, concentration, and impulsivity. Part of the success of READD in diagnosing ADD is related to the teaching of the task, which allows for unlimited teaching sequences. The clinical diagnosis is derived from the child's performance on the READD version of the CPT, with behavioral history from parents, rating scales from the teacher, and other psychoeducational testing. How to administer the READD is described, and its technical characteristics are outlined. Studies are cited that have supported the reliability and predictive validities of the READD. An appendix presents 24 tables of normative data. (Contains 22 references.) (SLD)

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RAGGIO EVALUATION OF ATTENTION DEFICIT DISORDER

READD

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REQUEST FOR RESEARCH DATA

Researchers investigating the validity, reliability, and utility of the READD with any population are urged to mail copies to either author:

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Arrangement may be possible in some situations to aid in research efforts.

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CHAPTER I

INTRODUCTION

One of the most frequent referrals to mental health clinics, physicians, and psychologists is for evaluation of children suspected to have attention deficit disorder with and without hyperactivity. Behavioral characteristics associated with attention deficit disorder as listed in the DSM-III-R include inattention, distractibility, impulsivity, restlessness, fidgetiness, and poor concentration. The diagnostic categories include ADHD which represents those children with attention deficit disorder and hyperactivity and UADD for those children diagnosed as attention deficit disorder without hyperactivity. The incidence in reporting attention deficit disorder (ADD) has increased sharply in the past few years with a leveling off currently at approximately 3 to 6 percent of the population.

The Raggio Evaluation of Attention Deficit Disorder (READD) is an objective measure used in a systematic approach for the diagnosis and management of attention deficit disorder. The READD has been used experimentally and clinically for approximately seven years. During that time extensive research, partially funded by the University of Mississippi Medical Center, has been conducted on its clinical and psychometric properties. The end result is hundreds of extensive evaluations of children referred for the evaluation of ADD. The final test used in the diagnosis of ADD came after much trial, error, and research.

Additional information should be obtained from parents, children, and school that allows the establishment of confident and valid diagnosis. The intent of READD is to provide a viable method of objective investigation that allows the psychologist to address the referral question posed by pediatricians, schools, parents, etc.

The impact of attention deficit disorder (ADD) on a child's academic functioning has been well documented. Although less well known, research suggests and clinicians, teachers and parents agree that many children with attention deficit disorder also have more difficulty forming positive social relationships and present more discipline problems at home. There is also research that suggests a greater propensity for difficulty with the legal system. Numerous treatment programs have been suggested that have included medication, behavioral techniques, and various cognitively oriented educational programs. In general, a multi-modal therapy program including all three components (cognitive, behavioral and medication) has proven most successful.

Although literally thousands of research articles have been published regarding the behavioral characteristics of children with attention deficit disorder and subsequent treatment approaches, there is still no standardized format for making the diagnosis. Rating scales such as the Conners Behavior Rating Scale (Conners, 1989; 1991) have been used almost exclusively in some way to establish the diagnosis.

Although rating scales such as the Conners and others have been shown to be valuable in assessing attention and impulsivity for diagnostic purposes there are many pitfalls associated with the use of rating scales. Parent scales have been shown to have many limitations partially due to rating of a child in a nonacademic, semi-structured environment. Often at home the child is in a situation where they interact on a one-to-one basis with other adults, they play outside and generally have less constraints on their behavior and attention even in teaching situations. The subjective nature of the scoring system allows the temperament of the respondent to effect the scores. Therefore it is not only the behavior of the child that is being measured. The perception of that behavior by the respondent is also being measured. Teacher rating scales seem to have more value than parent rating scales for diagnosing ADD, because they are based on academic structured interaction, but again suffer from many shortfalls.

Psychological tests such as the Wechsler Intelligence Scale for Children-Revised (WISC-R), Bender-Gestalt, and others have been used with minimal success in diagnosing ADD. A triad of subtests from the WISC-R (arithmetic, coding, and digit span) has been shown to be influenced by a child's ability to concentrate and attend. Other tests such as the Bender, through various scoring techniques, also have some diagnostic implications. Although the constructs of attention and impulsivity have been shown to impact test scores, most psychological tests were designed for measuring such constructs as intelligence (WISC-R)

or visual-motor perception (Bender) and were not specifically designed to measure attention or impulsivity. Therefore, the utilization of various psychological tests may be helpful clinically but are of questionable value diagnostically.

In recent years one test, the Continuous Performance Test (CPT) has shown increasing promise as a measure of attention, concentration, and impulsivity. The CPT was first described by Rosvold, Mirsky, Saranson, & Beck (1954) and was designed as a test of brain damage. The stimulus figure was presented on a Kodak Carousel projector. The subject was asked to make a response when a predecided letter combination appeared on the screen. Therefore, two types of errors could be recorded: omission errors (when the child did not respond in the presence of the stimulus) and commission errors (when the subject responded to a non-target stimulus). The test was shown to have some validity as a measure of brain damage.

In the years that have followed various configurations of continuous performance tests have been used with numerous other populations including emotionally disturbed children, and adult and child clients with specific learning disabilities (Eliason & Richman, 1987; Klee & Garfinkel, 1983). However, the vast majority of research has been with children thought to have attention difficulties similar to ADD with or without concurrent hyperactivity and impulse problems. Subsequent analysis of scores achieved on continuous performance tests suggest that omission errors are associated with inattention and commission

errors with impulsivity. Numerous studies have now validated the usefulness of CPTs in diagnosing attention deficit disorder (Meents, 1989). The computerized CPT is one of the most widely used measures of sustained attention (Meents, 1989). In recent years several authors have attempted to define the usefulness of the CPT for diagnostic purposes (Halperin, Wolf, Greenblatt, & Young, 1991; Halperin, Newcorn, Sharma, Healey, Wolf, Pasculvaca, & Schwartz, 1990; Richards, Samuels, Turnure, & Yesseldyke, 1990). However, computerized instruments which have been normed on normal and ADHD children so comparisons can be made are relatively scarce.

The vast majority of studies using CPTs with children with attention deficit disorder have simply noted their performance, and in some cases change in performance, as a result of behavioral intervention or medication therapy. However, some investigators have compared the CPT with a number of behavioral, intellectual, and achievement measures. For example, using a sample of child psychiatric patients, Klee and Garfinkel (1983) reported significant correlations between CPT errors and attention, as measured by both the Conners Teacher Rating Scale, and impulsivity, as measured by the Kagan Matching Figures Test. In addition, the arithmetic subtest of the Wechsler Intelligence Scale for Children-Revised (WISC-R) was reported to correlate significantly with CPT errors of omission. These authors argued that the CPT was most clearly related to impulsive behavior. In

a similar study, Gordon, Thomason, and Cooper (1990) conducted a correlational study using the CPT and the Kaufman Assessment Battery for Children (K-ABC) with a sample of 52 children with learning problems. Data indicated that correct responses and commission errors on the CPT significantly correlated with indices of cognitive ability and achievement on the K-ABC. These findings indicated that poor performance on intelligence and achievement tests was associated with attention difficulties. However, in both these studies, the sampled populations performed within the average range of functioning on tests of achievement suggesting that these samples may not reflect typical groups of LD or emotionally disturbed children. CPT performance of normal controls has been shown to differ from those of disabled children (Beale, Matthew, Oliver, & Corballis, 1987; Eliason & Richman, 1987).

To further investigate the relationship between CPT scores and measures of cognitive, achievement, and behavioral functioning, Halperin, Sharma, Greenblatt, and Schwartz (1991) administered the CPT and several measures of academic achievement to a group of referred boys. In this study, CPT scores appeared unrelated to the WRAT-R,. Peabody Picture Vocabulary Test-Revised (PPVT-R), or the PIAT-R. CPT commission errors were found to be related to the derived scores of inattention and dyscontrol and the WRAT-R reading subtest. Thus, the CPT was seen as a broad-band neuropsychological measure of cognitive, achievement, and behavioral functioning.

There are now several versions of the CPT in the marketplace but few, if any, include normative data for children with attention deficit disorder. The READD includes a version of the CPT which was standardized on normal children aged 6 to 13 years-old and also reports norms for children 5 to 9 years-old diagnosed with attention deficit disorder. Although additional information should be obtained to establish a diagnosis of ADD, the READD gives the examiner objective information regarding a child's performance in the areas of attention and impulsivity that are the cornerstones of the diagnosis of ADD.

Making the Diagnosis of ADD

To establish the diagnosis of ADD the overall assessment procedures should include a detailed behavioral history obtained from the parent(s), parent behavioral rating scales such as the Conners Parent Behavior Rating Scale (Conners, 1989), a teacher rating scale such as the Conners Teacher Rating Scale (Conners, 1991) or the ADD-H Comprehensive Teacher Rating Scale (Ullmann, Sleator, & Sprague, 1986; ACTeRS)*, and measures of intelligence and academic achievement necessary to determine the possibility

*There are now several excellent parent and teacher rating scales available and the only reason the Conners and ACTeRS are specifically mentioned here is that they were a standard part of the test protocol utilized over a seven year period.

of a specific learning disability, as well as the READD as an objective measure of attention and concentration.

Behavioral history obtained from parent(s) is important to give an overall perspective to questions regarding the diagnosis of attention deficit disorder. It is well established that attention deficit disorder typically exists over a long period of time and not something that is likely to manifest itself in a few short weeks. Short-term inattentive, hyperactive or impulsive behavior similar to the behavioral manifestations of ADD has been shown to be caused by environmental influences, such as trauma, abuse, etc, by short-term metabolic disturbances and by ingestion of drugs or alcohol. Although these problems can precipitate behavior similar to ADD, and ADD is a behaviorally defined disorder, conditions such as these in a detailed history would preclude a diagnosis of ADD. Quite often, parents in interview can trace the child's history of attentional problems back into the preschool years and before. Parents will often state that the child exhibited many problems of attention, impulsivity, restlessness, etc., as an infant or toddler but felt that the child might outgrow it. However, as the demand of school years begin the impact of the attention deficit disorder becomes more noticeable.

The parent(s) observation of the child in the home environment is extremely important. For this reason various parent rating scales are routinely used. The Conners Parent

Rating Scale has a long history and for many years existed almost exclusively as the primary diagnostic instrument in the field. The Conners Parent Scale is easily administered and quickly scored.

Teacher observation of a referred child is extremely important because the teacher interacts with students in a structured situation with high task demands which is qualitatively different than home demands and relationships. Also, when a child is in a group setting and distractions are numerous attention and concentration are more difficult. Therefore, teacher observations are frequently considered more valid in diagnosing ADD. Again, the ACTeRS and the Connars Scales are currently used for diagnostic purposes. The ACTeRS Rating Scale is preferred since it breaks down behavioral observations into components of attention, hyperactivity, social skills, and oppositional behavior. These classifications allow a differentiation between children who have ADD with hyperactivity and those who have ADD without the hyperactive behavior patterns. Additionally, various behavior patterns can be recorded. The Conners Teacher Rating Scale has been found to be less useful in differentiating children with attention deficit disorder without hyperactivity from those with hyperactivity.

Psychoeducational testing is often necessary because most children are referred for poor academic performance in school. It is often unknown at the time of testing whether the academic

difficulties result exclusively from ADD, are a combination of attentional problems and mild learning difficulties or whether severe learning disabilities could explain why the child might be experiencing problems with attention and concentration. It is quite common for attention deficit disorder and specific learning disability to exist concurrently. Therefore, it is recommended that an achievement test battery be administered to establish basic levels of sight word reading, reading comprehension, arithmetic, and spelling. There are many instruments available to do this. The Wide Range Achievement Test-Revised and Peabody Individual Achievement Test-Revised were selected as they have a high correlation with other achievement tests but do not take an excessive amount of time for administration.

Last, and in this author's opinion, the most important information for diagnosis is objective measures of attention and impulsivity obtained directly from measures of the child's behavior. The READD is administered and omission and commission errors recorded. READD scores can be easily classified into a range of mild, moderate and severe problems in the areas of attention and impulsivity.

With a behavioral history from parents, standardized parent rating scale, standardized teacher rating scale, psychoeducational testing and objective performance from the READD, the validity of the diagnosis of attention deficit disorder is improved greatly. Measures of a child's performance from this battery of instruments allows psychologists to speak

with confidence relative to the diagnosis and treatment of children with ADD. Once this information is obtained the chologist can competently answer the questions typically posed in the child referrals for academic difficulties, such as (1) does the behavior in question suggest attention deficit disorder, (2) are there other additional problems such as specific learning disability or emotional components present, and (3) once the diagnosis has been established what behavioral and educational recommendations are available and is the child a candidate for medication.

Diagnostic Interpretation

The clinical approach here is to evaluate the child's performance on the CPT with the behavioral history obtained from parents, rating scales required from teacher, and psychoeducational testing. If the psychoeducational test battery can rule out severe cognitive deficits as mental retardation the evaluation of the other assessment tools should proceed. If the behavioral history, parent and teacher rating scales and CPT are significant the diagnosis of attention deficit disorder can be made with a high degree of confidence.

The significance of inattention is established by the number of omission errors for chronological age. Likewise, the significance of impulsive behavior is established by the number of commission errors. If both omission and commission errors are

two standard deviations below the mean the disorder is classified as severe. If either the omission or commission error is two standard deviations below the mean with the other being one standard deviation below the mean the overall classification is moderate attention deficit disorder. When either the commission or omission errors are two standard deviations below the mean and the other in the normal range the classification is mild attention deficit disorder. If both commission and omission error scores are below one standard deviation the classification is mild. If either commission or omission errors are one standard deviation below the mean and the other in the normal range the classification is borderline.* Therefore, the utilization of the CPT with behavioral history obtained from parents and rating scales from parent and teacher increased greatly the accuracy of the psychologist in making a decision about attention deficit disorder.

*See Table A for READD scores and classification of ADHD

TABLE A

Diagnostic Classification of ADHD Based on Commission and Omission Error Scores

Omission Errors	Commission Errors	Severity of ADHD
>2 SD	>2 SD	Severe
>2 SD	>1 SD	Moderate
>1 SD	>2 SD	Moderate
>2 SD	Normal	Mild
Normal	>2 SD	Mild
>1 SD	>1 SD	Mild
>1 SD	Normal	Borderline
Normal	>1 SD	Borderline

Any combination of scores indicating mild, moderate or severe attention deficit disorder are considered significant enough to impact on school performance. Behavioral strategies and educational modification should always be considered first but medication would be considered in all of these diagnostic classifications. As the degree of severity increases the more likely medication will have to be considered in the treatment plan.

Borderline scores on the READD often indicate that behavioral and educational recommendations will be sufficient to manage the attentional disorder in the classroom. However, if borderline scores on the READD are accompanied by significant declines in school performance and significant teacher rating scales medication could then be considered.

TREATMENT OF ADD

Although not the intent of this manual a brief statement regarding treatment will be made. Research indicates a multi-modal approach has the best prognosis. To think of treating children with attention deficit disorder from a purely behavioral, educational, or medical prospective is extremely shortsighted. The combined approach seems to work best. There are now numerous articles and several books e.g. Barkley, R. A. (1990), Ingersol, B. (1988) that describe in detail this approach.

FOLLOW-UP

Periodic follow-up is essential to monitor changes in attention and performance. In principle, evaluation every 3-4 months if things are going well and more often if specific behavioral or educational techniques are necessary. If tutoring is being prescribed academic achievement tests need to be re-administered periodically to assess the changes in the specific academic areas of question.

The CPT is of immense value in monitoring changes, particularly those cases where medication has been prescribed. By continuing to track the performance of the child with the READD determines when the child's performance without medication is approaching normality. With this information one can make more reliable decisions regarding the discontinuance of medication.

CHAPTER 2

OVERVIEW OF READD

READD Materials

The READD is a microcomputer edition of the CPT that has been designed to be presented on various computers. Programs are available for Apple IIe, IBM, and IBM Compatibles. The program has been written in such a way as to maintain complete integrity as to length of time, interest stimulus, interval, etc. The READD/CPT has also been used successfully on various laptop computers. The presentation on laptop is convenient and allows for various types of psychological examinations. Since school psychologists and other professionals frequently must travel to test children in unique environments the mobility of the program was seen as necessary.

The program can be ordered for Apple or IBM DOS Systems on 3.5 or 5.25 size, high density or double density disks.

ADMINISTRATION

Part of the success of the READD in diagnosing the ADD child is related to the teaching of the task. Since the test is designed to measure impulsivity and attention the confound of understanding the instructions was removed by adding unlimited teaching sequences. The child is to be trained on the task until the examiner is sure the task is understood.

The task is simple and set up in a game format to be as enticing to the child as possible. The length of time, eight

minutes, is rather long for a child to attend. The time limit was purposefully set long to stress the child's ability to attend and inhibit impulsive reactions.

The examiner should remain in the room during the eight minutes of the test. However, interaction should not be encouraged. If the child asks questions simply state that the child is doing fine and should watch the screen.

INSTRUCTIONS FOR ADMINISTERING THE READD

After the disk is inserted type "READD" to execute the program. Prompts will then appear and select the number appropriate to initiate the test. Prompts will then appear asking for the child's name, date of birth and other information.

As the program is initiated a prompt will appear on the screen that asks the examiner for the number of random Xs he wishes to appear during the test administration. To comply with norms the following is recommended: for children age 5-10 the number of random Xs is 0. For children age 11-13 the number of random Xs is 20; for children over 13 the number of random Xs is 32.

The first portion of the test to appear is a sample test. The S is given the instruction and the sample test presented. If the S fails to understand or makes any mistakes the sample is repeated by pressing the ENTER key. If it is obvious that the child understands the test the N key is pressed and the test proper can be initiated by pressing any key.

_____ (child's name) I have a task/game that I would like for you to do. So watch the screen here (pointing with your finger). You will see some letters appear one at a time. Each time you see the letter A followed by the letter X, I want you to press the space bar here (pointing with your finger). As you watch the screen, when you see the letter A "get ready" because if the next letter that follows is an X press the space bar here. If you should see the letter followed by a B, Y, D or any other letter followed by the letter X do nothing. (*If you see the letter C, D or any other letter followed by the letter X do nothing) Only press the space bar when you see the letter A followed by the letter X. Now here is an example to make sure that you understand what you are supposed to do (example is presented, if there are any mistakes or misunderstandings the sample should be repeated). The sample problem can be repeated as many times as necessary for the child to understand the task. After the sample is completed and the child fully understands the directions then say: Now once the task/game starts it will run approximately eight minutes. At the end of the eight minutes the program will shut itself off automatically. You don't need to do anything. Continue to do just as you are doing now until the program stops. Do you have any questions? Ready (then start program). At the end of eight minutes the correct score, commission error score and omission error score will automatically appear on the screen (scores

should be recorded manually unless scores are being printed automatically).

*This statement is included for children age 11 and older.

CHAPTER 3

DEVELOPMENT AND STANDARDIZATION

Development of READD:

The READD was developed based on Rosvold, et al.'s (1956) work to give a more objective measure of a child's ability to attend and inhibit impulsive responding to inappropriate stimuli. The norms were created in order to compare scores across age groups and impairment levels after 4 years of clinical and experimental use of the test by various pediatricians and psychologists interested in an objective measure of attention and impulsivity.

Standardization: The standardization sample consisted of 361 6-to-13 year-old normal children, tested in their school systems and 271 5-to-9 year-old children referred for learning problems and ADD. The referred children were tested in a child development clinic in a regional medical center. The gender and race of all the children were not recorded. All the children assessed came from one southern state.

Other Data Collected: Conners were collected on the referred children and ACTeRS were collected on the normal children used for the standardization norms.

Norms Developed: Data collection during the READD standardization were analyzed using classical statistical methods. Percentile scores were computed for each age group from

the raw error scores provided by the computer program using the Statistical Package for the Social Sciences - Personal Computer Plus version (Norusis, 1988, SPSS/PC+). Percentile scores were then converted to *t*-scores and standard scores with a mean of 100 and a standard deviation of 15. Separate norms were developed for the normal sample (n = 361) and for the sample of children diagnosed with ADD (n = 271). Norms Tables can be found in Appendix A.

CHAPTER 4

TECHNICAL CHARACTERISTICS

This chapter provides evidence of the technical adequacy of the READD, documenting the reliability and validity of the instrument. Over the four years the READD has been used clinically and experimentally, research has been conducted by both the author of the test and independent researchers. The results from all relevant studies, published or unpublished, are reported in this chapter.

Face Validity: Although face validity is not a true test of the validity of an instrument it has an impact upon the choice and sustained use of an instrument. The notion upon which CPT tests are predicated seems logical. The task of responding to a stimulus amid a monotonous background implies an attentional element. The inhibition of responding until the last of a set of stimuli appears reasonable as a measure of impulsivity.

Validity Studies: The validity of a measure ultimately depends upon whether the results of the test measures whatever the test purports to measure. In the case of the READD, the intent is to measure ability to attend and the ability to inhibit impulses, usually referred to as attention and impulsivity. Furthermore, validity cannot be assessed for a test outside the context in which it is given. In other words a test is valid for a specific population under specific conditions.

Content validity refers to the representativeness or sampling adequacy of the content included in the measure compared to the content on which the test is based. Content validity is usually consensual in nature, i.e., basically judgmental. The content domain of the READD consists of measures of attention and impulsivity. Research supports the notion that measures of attention and impulsivity are necessary but not sufficient for the diagnosis of Attention Deficit Disorder.

Construct validity indicates the degree to which a test measures the theoretical constructs upon which it was based. The constructs underlying the READD are thought to be attention and impulsivity. Several studies have been conducted to examine the relationship of the READD with commonly accepted measures of attention, impulsivity, academic achievement and intelligence.

Lassiter, D'Amato, Raggio, Whitten, and Bardos (1991)

Lassiter, D'Amato, Raggio, Whitten, and Bardos (1991) evaluated the construct specificity of the READD with measures of behavior and achievement in a sample of 104 children referred for learning difficulties. The children ranged in age from 6 years to 16 years (M = 8, SD = 2).

Behavior was measured by the attention, hyperactivity, social skills and oppositional behavior scales of the ACTeRS and the Abbott Hyperkinesis-Hyperactivity index from the Conners Parent Behavior Rating Scale. Both Conners and ACTeRS scores were converted to standard scores (M = 100, SD = 15) to assist in statistical analysis of the data.

Achievement was measured by the PIAT-R reading comprehension subtest and the reading, spelling and arithmetic subtests of the WRAT-R.

Partial correlations were computed for the READD scores and the behavior scores to remove significant age effects. According to the authors results of the correlations indicated that the subjects performed in the average range on all measures of achievement. On measures of behavior the children were shown to exhibit significant scores in the areas of attention and hyperactivity.

READD omission scores were not found to be significantly correlated with any of the behavioral measures. Commission scores were significantly correlated with the measures of hyperactivity (Abbott Hyperkinesis-Hyperactivity Index from the Conners Parent Rating Scale, $p < .01$), and oppositional behavior (Oppositional Behavior Scale from the ACTeRS, $p < .05$).

Raggio, Lassiter, D'Amato and Bardos (1991)

In a similar study using 55 children referred for learning problems Raggio, Lassiter, D'Amato and Bardos (1991) found that the READD commission scores correlated significantly with the ACTeRS oppositional factor ($r = -27$, $p < .05$,), and with the Abbott Hyperkinesis-Hyperactivity Index from the Conners Parent Behavior Rating Scale ($r = -.32$, $p = < .05$).

Campbell, D'Amato, & Raggio, (1991)

A factor analytic study conducted by Campbell, D'Amato, and Raggio (1991) using 54 children referred for learning difficulties, revealed four interpretable factors. Only total READD errors were used for this study in conjunction with scores from the WISC-R (cognitive ability), WRAT-R (academic achievement), Bender (visual-motor integration), PIAT-R reading comprehension subtest (academic achievement) and the Abbott Hyperkinesis-Hyperactivity index from the Conners Parent Behavior Rating Scale (hyperactive behavior).

The READD was found to load on Factor 1 with measures of academic achievement from the WRAT-R, suggesting a relationship to academic achievement. It was also interesting to note that in this study the Abbott Hyperkinesis-Hyperactivity index from the Conners Parent Behavior Scale fell in a factor by itself, did not load significantly on any other factor and accounted for less of the variability in scores than any other factor/measure.

Criterion-related validity refers to the relationship of a test to clinically meaningful criteria. For the READD this could be accomplished by investigating its relationship to criteria such as concurrent correlations to known measures of attention and impulsivity or its predictive validity for future measures of attention and impulsivity.

The concurrent validity of a test is assessed by relating its scores to some other measure that is administered at the same time and felt to be measuring the same underlying constructs.

The second measure is usually chosen to be a well known test believed to measure the same or similar traits.

Predictive validity investigates the extent to which performance on a measure can predict some future occurrence assumed to be related to the underlying constructs of the measure.

Raggio, Whitten, & Shine (unpublished)

In an unpublished study with 43 at-risk children, Raggio, Whitten and Shine examined the READD in relation to measures of behavior, intelligence and neuropsychological impairment. The children were 5 to 7 years old and originally were from a cohort of medically at-risk infants. Raggio et al. examined the READD commission and omission scores with the WRAT-R reading, spelling and math subtests as measures of academic achievement; the age appropriate Wechsler scale as a measure of cognitive functioning; and selected tests from the Reitan-Indiana Neuropsychological Battery for Young Children as a measure of neuropsychological impairment. Omission errors were found to be correlated with academic achievement (the WRAT-R reading subtest [$p < .01$] and with the WRAT-R spelling and arithmetic subtests [$p < .001$] and with cognitive ability (Wechsler scales [$p < .001$]). Commission errors were found to be highly correlated with cognitive ability (Wechsler scale [$p < .01$]) and academic achievement (WRAT-R spelling [$p < .001$]). The READD did not

appear significantly related to neuropsychological impairment as measured by a dichotomous impairment rating.

Reliability Studies:

Interrater reliability: Interrater reliability measures the consistency of scores on the same child as rated by different evaluators. Interrater reliability is not a major issue for the computerized CPT. The computer generates the scores and displays them at the end of the session.

Test-retest reliability refers to the extent that a client's scores remain stable over multiple administrations of the same measure. No test-retest studies have been conducted on the READD. However, test-retest for CPT tests have been shown by several studies to be moderately stable over time as long as age is accounted for. In fact, this stability is necessary for CPT tests to be used as indicators of the efficacy of different types of therapies.

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APPENDIX A
Norms Tables

Table I

6-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	98	71	131
1	89	62	118
2	81	59	113
3	76	57	111
4	69	55	108
5	54	51	102
6	50	50	100
7	42	48	97
8	39	47	95
9	35	46	94
10	31	45	92
11	28	44	91
12	23	43	89
13	23	43	89
14	22	42	88
15	22	42	88
16	21	42	88
17	20	42	87
18	18	41	86
19	16	40	85
20	15	40	84
21	14	39	84
22	13	39	83
23	12	38	82
24	11	38	82
25	10	37	81
26	9	37	80
27	8	36	79
28	4	32	74
29	1	27	65

Table 2

7-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	91	63	120
1	84	60	115
2	80	58	113
3	77	57	111
4	70	55	108
5	66	54	106
6	54	51	102
7	46	49	98
8	39	47	96
9	32	45	93
10	24	44	89
11	22	43	88
12	20	42	87
13	14	39	84
14	13	39	83
15	10	37	81
16	7	35	78
17	6	34	77
18	4	32	74
19	3	31	72
20	2	29	69
21	1	27	65

Table 3

8-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	86	61	116
1	72	56	109
2	65	54	106
3	49	50	100
4	42	48	97
5	37	47	95
6	30	45	92
7	28	44	91
8	21	42	88
9	20	42	87
10	19	41	87
11	18	41	86
12	16	40	85
13	12	38	82
14	9	37	80
15	8	36	79
16	7	35	78
17	5	34	75
18	4	32	74
19	3	31	72
20	2	29	69
21	1	27	65

Table 4

9-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	80	58	113
1	74	56	110
2	51	50	100
3	33	46	93
4	25	43	90
5	18	41	86
6	14	39	84
7	10	37	81
8	8	36	79
9	6	34	77
10	4	32	74
11	3	31	72
12	2	29	69
13	1	27	65

Table 5

10-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	75	57	110
1	59	52	103
2	41	48	97
3	22	42	88
4	15	40	84
5	12	38	82
6	9	37	80
7	6	34	77
8	5	34	75
9	4	32	74
10	3	31	72
11	2	29	69
12	1	27	65

Table 6

11-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	56	52	102
1	31	45	92
2	16	40	85
3	11	38	82
4	3	31	72
5	1	27	65

Table 7

12-year-old Normative Data for Omission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	70	55	108
1	40	47	96
2	30	45	92
3	28	44	91
4	26	44	90
5	24	43	89
6	22	42	88
7	21	42	88
8	20	42	87
9	15	40	84
10	10	37	81
11	5	34	75
12	1	27	65

Table 8

6-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	91	63	120
1	89	62	118
2	65	54	106
3	58	52	103
4	54	51	102
5	50	50	100
6	46	49	48
7	39	47	96
8	31	45	92
9	15	40	84
10	12	38	82
11	8	36	79
12	4	32	74
13	2	29	69
14	1	27	65

Table 9

7-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	95	66	125
1	86	61	116
2	77	57	111
3	70	55	108
4	60	53	104
5	56	52	102
6	49	50	100
7	40	47	96
8	33	46	93
9	31	45	92
10	25	43	90
11	17	40	86
12	11	38	82
13	9	37	80
14	6	34	77
15	3	31	72
16	2	29	69
17	1	27	65

Table 10

8-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	93	65	122
1	67	54	107
2	58	52	103
3	47	49	99
4	44	48	98
5	40	47	96
6	30	45	92
7	23	43	89
8	16	40	85
9	12	38	82
10	9	37	80
11	5	37	80
12	3	31	72
13	2	29	69
14	1	27	65

Table 11

9-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	94	66	123
1	72	56	109
2	53	51	101
3	45	49	98
4	33	46	93
5	27	44	91
6	23	43	89
7	8	36	79
8	6	34	77
9	4	32	74
10	2	29	69
11	1	27	65

Table 12

10-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	76	57	111
1	59	52	103
2	41	48	97
3	27	44	91
4	22	42	88
5	19	41	87
6	14	39	84
7	10	37	81
8	7	35	78
9	5	34	75
10	3	31	72
11	2	29	69
12	1	27	65

Table 13

11-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	71	56	108
1	42	48	97
2	29	44	92
3	18	41	86
4	11	38	82
5	7	35	78
6	6	34	77
7	5	34	75
8	2	29	69
9	1	27	65

Table 14

12-year-old Normative Data for Commission Errors Standardization Sample

Raw Score	Percentile Score	T Score	SS Score
0	70	55	108
1	60	53	104
2	40	47	96
3	20	42	87
4	1	27	65

Table 15

5-year-old Normative Data for Omission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0-11	91	63	120
12	86	61	116
13	82	59	114
14	79	58	112
15	76	57	111
16	73	56	109
17	71	56	108
18	69	55	108
19	67	54	107
20	65	54	106
21	63	53	105
22	61	53	104
23	59	52	103
24	57	52	103
25	54	51	102
26	45	49	98
27	36	46	95
28	31	45	92
29	27	44	91
30	18	41	86
31	16	40	85
32	14	39	84
33	12	38	82
34	10	37	81
35	8	36	79
36	6	34	77
37	1	27	65

Table 16

6-year-old Normative Data for Omission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0-3	99	73	135
4	98	71	131
5	97	69	128
6	95	66	125
7	92	64	121
8	91	63	120
9	90	63	119
10	87	61	117
11	85	60	116
12	82	59	103
13	77	57	111
14	76	57	111
15	74	56	110
16	72	56	109
17	69	55	108
18	67	54	107
19	64	54	105
20	62	53	105
21	52	50	101
22	48	50	99
23	44	48	98
24	39	47	96
25	34	46	94
26	32	45	93
27	31	45	92
28	28	44	91
29	26	44	90
30	23	43	89
31-32	22	42	88
33	19	41	87
34	14	39	84
35	13	39	83
36	11	38	82
37	9	37	80
38-39	8	36	79
40-41	7	35	78
42-43	6	34	77
44	5	34	75
45	2	29	69
46	1	27	65

Table 17

7-year-old Normative Data for Omission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0	99	73	135
1	98	71	131
2	97	69	128
3	95	66	125
4	93	65	122
5	91	63	120
6	88	62	118
7	85	60	116
8	83	60	114
9	76	57	111
10	71	56	108
11	67	54	107
12	59	52	103
13	55	51	102
14	47	49	99
15	44	48	98
16	40	47	96
17	39	47	96
18	33	46	93
19	28	44	91
20	27	44	91
21	25	43	90
22	22	42	88
23	19	41	87
24	16	40	85
25	15	40	84
26	11	38	82
27-28	10	37	81
29	9	37	80
30	7	35	78
31	5	34	75
32	3	31	72
33	1	27	65

Table 18

8-year-old Normative Data for Omission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0-1	99	73	135
2	98	71	131
3	95	66	125
4	87	61	117
5	80	58	113
6	77	57	111
7	74	56	110
8	70	55	108
9	66	54	106
10	62	53	105
11	54	51	102
12	50	50	100
13	47	49	99
14	43	48	97
15	41	48	97
16	33	46	93
17	31	45	92
18	25	43	90
19	18	41	86
20	15	40	84
21	13	39	83
22-23	11	38	82
24	10	37	81
25	9	37	80
26	7	35	78
27	6	34	77
28	5	34	76
29	5	34	75
30	4	32	74
31	4	32	73
32	3	31	72
33-35	3	31	71
36-39	2	29	69
40	1	27	65

Table 19

9-year-old Normative Data for Omission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0-2	99	73	135
3	92	64	121
4	85	60	116
5	54	51	102
6	46	49	98
7	39	47	96
8	36	46	95
9	33	46	93
10	31	45	92
11	23	43	89
12	15	40	84
13	13	39	83
14	12	38	82
15	11	38	82
16	10	37	81
17	9	37	80
18	8	36	79
19	1	27	65

Table 20

5-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0	99	73	135
1	98	71	131
2	96	68	126
3-5	95	66	125
6	94	66	123
7	92	64	121
8	91	63	120
9	89	62	118
10	86	61	116
11	82	59	114
12	76	57	111
13	70	55	108
14	64	54	105
15	63	53	105
16	61	53	104
17	60	53	104
18	58	52	103
19	56	52	102
20	55	51	102
21	54	51	102
22	53	51	101
23	51	50	100
24	50	50	100
25	49	50	100
26	47	49	99
27	45	49	98
28	40	47	96
29	36	46	95
30	35	46	94
31	34	46	94
32	33	46	93
33	32	45	93
34	31	45	92
35	30	45	92
36	29	44	92
37	28	44	91
38	27	44	91
39	26	44	90
40	25	43	90
41	24	43	89
42	22	42	88
43	21	42	88
44	19	41	87

Table 20 (continued)

5-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
45	17	40	86
46	16	40	85
47	12	38	82
48	10	37	81
49	9	37	80
50	8	36	79
51	7	35	78
52	6	34	77
53	5	34	75
54	4	32	74
55	3	31	72
56	2	29	69
57	1	27	65

Table 21

6-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0-4	99	73	135
5-7	98	71	131
8	97	69	128
9	95	66	125
10	94	66	123
11	93	65	122
12	92	64	121
13	90	63	119
14	88	62	118
15	77	57	111
16	76	57	111
17	75	57	110
18	67	54	107
19	64	54	105
20	61	53	104
21	57	52	103
22	56	52	102
23	55	51	102
24	54	51	102
25	51	50	100
26	49	50	100
27	46	49	98
28	44	48	98
29	41	48	98
30	39	47	96
31	36	46	95
32	33	46	93
33-35	32	45	93
36-38	31	45	92
39	26	44	90
40	25	43	90
41	24	43	89
42-44	23	43	89
45-46	22	42	88
47	21	42	88
48	18	41	86
49-50	17	40	86
51-52	16	40	85
53-55	15	40	84
56-58	14	39	84
59-61	13	39	83
62	12	38	82

Table 21 (continued)

6-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
63	10	37	81
64-66	9	37	80
67-68	8	36	79
69-73	7	35	78
74-77	6	34	77
78-81	5	34	75
82-85	2	29	69
86	1	27	65

Table 22

7-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0-2	99	73	135
3	98	71	131
4	97	69	128
5	93	65	122
6-7	89	62	118
8	88	62	118
9	81	59	113
10	76	57	111
11	74	56	110
12	73	56	109
13	72	56	109
14	65	54	106
15	62	53	105
16	56	52	102
17	52	50	101
18	49	50	100
19	42	48	97
20	41	48	97
21	40	47	96
22	38	47	95
23	35	46	94
24	34	46	94
25	33	46	93
26	32	45	93
27-28	31	45	92
29	30	45	92
30	29	44	92
31-32	28	44	91
33	26	44	90
34-35	24	43	89
36	22	42	88
37-39	21	42	88
40-42	20	42	87
43	18	41	86
44	17	40	86
45	13	39	83
46	12	38	82
47-48	10	37	81
49	9	37	80
50	8	36	79
51-52	7	35	78
53-55	6	34	77
56-58	5	34	75

Table 22 (continued)

7-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
59	4	32	74
60-62	3	31	72
63	2	29	69
64	1	27	65

Table 23

8-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0	99	73	135
1	98	71	131
2	97	69	128
3	95	66	125
4	93	65	122
5	91	63	120
6	90	63	119
7	85	60	116
8	77	57	111
9	70	55	108
10	62	53	105
11	57	52	103
12	54	51	102
13	47	49	99
14	44	48	98
15	42	48	97
16	39	47	96
17	36	46	95
18	35	46	94
19	34	46	94
20	31	45	92
21	29	44	92
22	24	43	89
23-24	23	43	89
25	21	42	88
26	19	41	87
27	18	41	86
28-29	17	40	86
30	16	40	85
31	14	39	84
32-33	13	39	83
34	12	38	82
35	10	37	81
36	9	37	80
37-42	8	36	79
43-50	7	35	78
51-57	6	34	77
58	5	34	75
59	4	32	74
60-94	3	31	72
95-120	2	29	69
121-128	1	27	65

Table 24

9-year-old Normative Data for Commission Errors Attention Deficit Sample

Raw Score	Percentile Score	T Score	SS Score
0	99	73	135
1	97	69	128
2	96	68	126
3	95	66	125
4	94	66	123
5	93	65	122
6	92	64	121
7	70	55	108
8	62	53	105
9	54	51	102
10	46	49	98
11	43	48	97
12	39	47	96
13	35	46	94
14	31	45	92
15	27	44	91
16	23	43	89
17	22	42	88
18	21	42	88
19	20	42	87
20	19	41	87
21	17	40	86
22	16	40	85
23	14	39	84
24	13	39	83
25-26	12	38	82
27-28	11	38	82
29-30	10	37	81
31-32	9	37	80
33-34	8	36	79
35-36	7	35	78
37-38	6	34	77
39-40	5	34	75
41-42	4	32	74
43-44	3	31	72
45-47	2	29	69
48	1	27	65